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ABSTRACT

Focusing on the sequence of cognitive processes of spellers of varying ability, a study evaluated the effectiveness a teaching package that adapts Robert Dilt's spelling strategy to the college classroom. Subjects, 25 students from an introductory level psychology class, were divided into three groups, each of which participated in two one-hour sessions involving spelling pretests and posttests. One experimental group was trained in a generative spelling strategy using visual imagery, another was taught standard spelling rules, and the control group received no training. Analysis of results indicated that the spelling of both experimental groups improved considerably more than that of the control group, but that the generalization of training to new spelling lists was only effective with the group trained in the use of visual imagery. (The usefulness of parallel visual and phonetic spelling strategies is discussed, and the spelling package is used as an example to discuss several general theoretical principles in designing methods to teach cognitive strategies. A figure illustrating the test results and three pages of references are included.) (JD)

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Principles for Teaching Cognitive Strategies: The Case of Spelling

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Running Head: PRINCIPLES FOR TEACHING COGNITIVE STRATEGIES

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Abstract

A framework for considering the nature of cognitive strategies is presented, along with a college classroom package for teaching a visual spelling strategy derived from the framework. In an experiment evaluating the effectiveness of the cognitive spelling package one group was taught to spell via the spelling package, a second group via standard spelling rules, and a third group was not trained. Both training groups showed significant improvement in spelling from pre- to post-tests compared to the no-training control. The spelling package group showed generally larger spelling gains than did the standard training group. Only the spelling package group showed significant generalization to new lists of words. The usefulness of parallel visual and phonetic spelling strategies is discussed. The spelling package is used as an example to discuss several general theoretical principles in designing methods to teach cognitive strategies.

Cognitive Strategies and a Classroom Procedure for Teaching Spelling

Spelling provides a well-defined context for the discussion of a framework specifying the nature of cognitive strategies as well as the elucidation of important design principles for generating methods of teaching cogntive strategies. While we have made substantial progress in theoretical frameworks for writing as process, the question remains (e.g., Harris, 1983), do we have classroom procedures for teaching process? This paper will focus on explicit classroom techniques for teaching spelling to demonstrate process approaches to teaching. There are many theoretical orientations for speaking of cognitive strategies, the approach taken here is based on a framework that is explicit and that has proven useful in psychotherapy (Dilts, Grinder, Bandler, and DeLozier, 1979) and education (Dilts, 1983).

Personal strategies. A strategy is an ordered sequence of cognitive-behavioral experiences that is repeated in the same or similar contexts. As experience is personal, so must strategies be. For example, when I tie my shoelaces in the morning, there is a sequence of experiences--mostly of small muscle sensations and skins pressures in my fingers--that are repeated from past shoe-tying contexts. Even though millions of people tie their shoes each day, the exact sequence of my experiences, probably slightly different from anyone else's, must occur for me personally if my shoes are to be tied. While I will discuss strategies abstractly and symbolically, almost as if they are extant entities in themselves, for the purpose of teaching, it is crucial to hold in mind that each learner must come to a sequence of experiences that functions well personally. The fact that this strategic knowledge is

personal does not mean, however, that active teaching is not useful. Three or four year old children, faced with untied laces, are rather unlikely to discover effective knots on their own. Active teaching is essential. In whatever manner we teach the child knots--pictures of knots, stories of rabbits popping out of holes and running around trees, or demonstrations of finger movements--our teaching must be aimed at providing a context in which children create sequences of personal experiences that produce knots for each of them. This paper deals with a Spelling Package that takes students through a strategic sequence of experiences that produces standard spelling.

For many theorists the crucial building blocks of cognitive strategies are the various types of codes (or representational systems) involved in human thought and action. Personke and Yee (1966), Grinder and Bandler (1976), Simon (1976) and Marchant and Malloy (1984), among others, all have proposed at least three important ways of representing sensory input. These theorists posit visual, auditory, and kinesthetic cognitive systems for representing and processing information. From this point of view a person has the ability to see visual images, to hear internal sounds, including internal voice, and to feel the sensations of motoric behavior along with various other internal and external feelings such as emotions, hot, cold, pressure, etc. Tying a knot may involve any combination of these three codes; remembering a picture of a knot may help, saying words like "right over left, then left over right" may help, or moving our fingers may do it.

Spelling Strategies. In the Dilts et al. (1979) system, which is evolved from the Miller, Galanter, and Pribram (1960) TOTE model, strategies are described in terms of the content-free process of a

person's experience moving in sequence from one representational system to another. For example, suppose someone asks aloud how to spell "Albuquerque." Dilts (1983) found that many excellent spellers will take this auditory input and convert it into a remembered visual image of the word "Albuquerque." If this image gives them a feeling of familiarity they will output (write or speak) by reading off the visual image. Removing the content from this description, structurally the strategy moves from an external auditory experience into internal visual experience into internal kinesthetic experience into appropriate kinesthetic experience for output. If V represents visual representations, A auditory, K kinesthetic, and i and e represent internally and externally initiated processes, the structure of this spelling strategy can be expressed in shorthand notation (Dilts et al., 1979) as: Ae --> Vi --> Ki --> K. Different spellers, of course, use different strategies. These strategies are viewed as learned, not inherited, and they change within a person depending on task demands and context. Often they are overlearned and automatic and therefore not conscious, as is sometimes the case with a well-learned knot. Just because a strategy is well-learned and unconscious does not mean that the underlying sequences of experiences cannot be uncovered and taught.

Certainly, writers use diverse spelling strategies. Both Dilts (1983) and Marsh, Friedman, Welch, and Desberg (1980) report evidence of spelling strategies in which visual imagery is crucial. Such a speller is most easily identified with the "Chinese" type person who uses word specific associations in reading and spelling (Baron 1979; Baron, Treiman, Wilf & Kellman, 1980). On the other hand, there is a class of phonetic spelling strategies based primarily on auditory representations (e.g., Barron,

1980; Frith, 1980). People primarily using such strategies have been called "Phonecians" (Baron, 1979). Further, Simon (1976) suggests that there are kinesthetic spelling strategies involving the hand movements necessary for output; in essence, when we are typing, we let our fingers do the spelling. These different strategies are not, of course, mutually exclusive. Barron (1980) suggests that they can run in parallel, while Personke and Yee (1963) and Baker (1980) assert that situational variables and task demands determine which of many strategies may be used. In general, the more strategies people have available to do a task, the more options they have for performing effectively. It is in this sense that the present study proposes and evaluates a visual imagery spelling strategy, not as opposed to other strategies, but as an effective, parallel, alternative that is easily taught in the college classroom.

That visual imagery strategies can be involved in spelling is well documented, e.g., Ehri (1980), Dobie (1986). That visual representations of words have real advantages is also well documented. Standard English spelling is chaotic (Baron et al., 1980) with no straightforward phonetic representations (Baker, 1980) so that a visual representation may be necessary to spell irregular words. Indeed, there is some evidence that teaching a visual strategy can improve the spelling of words (Radaker, 1963) and nonsense syllables (Ehri, 1980). Sloboda (1980) suggested that knowledge of spelling rules may distinguish poor from competent spellers but that excellent spellers need more specific information for cases where the rules do not provide unique spellings. Dilts (1983) and Marsh et al. (1980) both found that very proficient spellers make use of visual information. This is consistent with a large literature (e.g., Paivio, 1971, pp. 327-352) showing that instructions to engage in visual imagery

strategies leads to improved memory performance for verbal materials relative to instructions to engage in auditory strategies.

In studying the sequence of cognitive processes of excellent spellers and contrasting them with those of poor spellers, Dilts (1983) has developed the spelling strategy (described above) in which visual imagery is the key element. As such it represents a detailed elaboration for teaching the sensory development of visualization suggested by Dobie (1986). The present study describes a teaching package that adapts Dilts' spelling strategy to the college classroom and then reports data regarding the effects of this teaching package on the spelling performance of college students. This Spelling Package carefully guides students through a sequence of experiences aimed at producing standard spelling.

Method

Design. The spelling experiment comprised three groups, each of which participated in two one-hour sessions one week apart. The Imagery Group was trained in a generative spelling strategy using visual imagery. The purpose of this group was to evaluate the effectiveness of the imagery strategy. The Auditory Rule Group was taught standard spelling rules, e.g., "i before e except..." When studying word lists subjects in this group were instructed to use these standard rules and to repeat the spelling of words using their inner voice. An extensive literature (e.g., Paivio, 1971) of carefully controlled laboratory studies has shown that the effect of imagery instructions on memory for verbal material is not due to procedural artifacts such as number of rehearsals. Building on this basic research knowledge base, the design of the present study evaluates the effectiveness of imagery instructions at the more molar level of classroom instruction. Thus, the purpose of the Auditory Rule

Group was to control for placebo effects, positive set, and demand to perform well on spelling tests by giving a group of subjects contact with the experimenter which was comparable to that of the Imagery Group. The purpose of this group was not to replicate already established laboratory controls nor was it a rigorous evaluation of the effectiveness of standard spelling rules. The Control Group received no training; these subjects simply took the spelling tests. The purpose of the Control Group was to establish the baseline difficulty of the spelling tests against which to measure improvement due to training.

Each group was given four spelling tests, a pretest at the beginning of session one and three posttests at the end of session two. The three posttests probed two conditions affecting spelling memory for a list of words: (1) Twenty minutes versus one week time delay between the learning and testing of a word list; and (2) explicit experimenter-controlled guidance versus subject-controlled generalization in the use of a strategy to learn a word list. The Guidance and Twenty-minute Delay test was given twenty minutes after subjects were guided by the experimenter in the use of a strategy to learn a word list. The Guidance and One-week Delay test was given one week after subjects were guided through a strategy to learn a word list. The Generalization and One-week Delay test was given one week after subjects were asked to generalize their training by using the strategy appropriate to their group to learn a word list. In this latter case subjects were not guided explicitly through the strategy for learning the word list.

Subjects. Twenty-five subjects were recruited from Introductory Psychology classes and received extra course credit for participation. One subject (in the Imagery Group) failed to show up for the second

session and was dropped from the experiment. Subjects were recruited in groups rather than individually: Three sign-up sheets were posted and all subjects who signed up on a given sheet were run together and constituted one of the three groups. Ten subjects signed up for the Imagery Group, seven for the Auditory Rule Group, and Eight for the Control Group. The purpose of running subjects in groups was to simulate classroom conditions.

Materials. There were four lists of twenty words each. The eighty words were taken from the lists of Fergus (1983). Each list of twenty contained four words from each of the following categories: (1) silent letters (debt); (2) sound-alike suffixes (ible-able, ary-ery, ise-ize-yze, ance-ence); (3) ie-ei; (4) doubling final consonant or not (witty, taxing); and (5) variant plurals (wives).

The eighty words were printed individually on large flash cards that could be seen by a group. Test sheets were provided to subjects for the spelling tests.

Each subject in the the Auditory Rule Group was given a handout which contained rules for ie-ei, variant plurals, dropping a final "e" before a vowel, doubling consonants, homonyms, and suffixes. This handout included a paragraph with numerous misspellings to correct and a list of 79 correctly-spelled practice words to study. Six of these 79 words were on one of the four spelling tests.

Description of Spelling Package. The training of the imagery strategy was based on Dilts (1983) but modified for the present study. The strategy taught here triggers off either an internal or external auditory experience of a word which is translated into an internal visualization of the word marked by special visual characteristics (e.g., a favorite color)

which evokes a feeling of familiarity. If the visualized word has the appropriate characteristics and is familiar it is then output by appropriate kinesthetic movements. This can be expressed as: A(e or i) --> Vi/Vi --> Ki --> K, where the slash indicates comparison. The comparison is to make sure that current visualization of the word has the special visual characteristics.

Training consisted of five steps designed to evoke a sequence of experiences within each subject that follows the above abstract outline of a spelling strategy. In the construction of knowledge, personal experience is primary. Thus it is important that each person learning the spelling strategy have all the component experiences and be able to sequence them in a functional way. This is important to remember when applying these techniques in the classroom.

The first step established a visual imagery reference experience so that the term "visual imagery" referred to the same type of cognitive experience for the subjects and experimenter. The subjects were asked to recall "the house before the house you are now living in and tell which way the front door opened--right or left." They were also asked to picture how someone they know well looks when happy, sad, and angry; and to picture scenes from recent movies. This is an important step because people are often confused by the request to make a visual image. For example, many people have excessively high standards for visual images, expecting them to be as clear as a photo. Giving people simple imagery tasks that they can succeed at allows them to become familiar and comfortable with the experience of manipulating imagery. The second step established reference experiences for the visualization of words. Subjects were asked to visualize the address on the front of their houses,

their names on mailboxes or nameplates, a familiar billboard slogan, and a movie title, such as "Star Wars."

The third step trained visualization in spelling. Subjects were shown a flash card with a short word on it. They were asked to look at the word and then to look up and visualize it, looking back at the card as many times as necessary. Subjects were encouraged to close their eyes or to stare at the ceiling while visualizing the correct spelling and to visualize it in some way that marked it as distinct from other visual word memories. They might visualize it in their favorite color, in a particular script, with a frame around it or they might use any other visual marker that was effective.

This visual marking is useful since at the time of recall it allows subjects to distinguish marked, correctly-spelled visual memories from unmarked and possibly incorrectly-spelled memories. This is important since many subjects have built up an internal dictionary of incorrectly visualized words through the use of inappropriate spelling strategies. In terms of shorthand for the strategy, at the time of recall the visual marking (e.g. green words) allows the subjects to compare (Vi/Vi) their memory for a word to see if it is marked correctly (green). Subjects were told to practice this visualization until the marked visual image gave them a feeling of familiarity. It should be noted that Dilts (1983) strongly suggests that subjects look up and to the left while visualizing the correct spelling, but this was not done in the present study.

When all subjects indicated that they could visualize the word, the card was removed and one subject, on an irregular basis, was asked to spell the word backwards. The ability to spell a word backwards is one criterion for determining if a subject is using a visual as compared to a

phonetic (auditory) strategy. A clear visual image can be read backwards nearly as well as frontwards. In contrast it is nearly impossible to sound out many words (e.g., Albuquerque) backwards in the same way that audio tapes do not sound the same when run backwards. While clear imagery of a word makes spelling it backwards relatively easy, vague imagery, or no imagery at all, makes this task difficult. Therefore, in teaching a visualization strategy, asking people to spell backwards as well as forward is an easy way to discover those who are relying on phonetic strategies or who have vague imagery. It also convinces people that they must learn to picture words so they can answer questions.

The experimenter continued to show short words, asking subjects to spell backwards and frontwards. When subjects successfully spelled a word, they were asked to notice and develop the feeling of familiarity that the marked image gave them. Some subjects learned this strategy quickly; others did not. Those who did not were told to change the size, shape, or color of the visualized words or to put frames around them if these operations made remembering images easier. Subjects who had difficulty were frequently called on to spell backwards until all could do the task well. Then the length of the words was increased.

The fourth step was "chunking" (e.g., Miller, 1956) long words. Many people can visualize long words, but others cannot. Subjects who could not visualize long words were asked to visualize them farther away or smaller, which sometimes helps. If they were still unable to visualize long words subjects were taught to chunk long words into small parts--preferably not syllables, visualizing each chunk separately. They were taught to overlap the chunks so that there was a natural bridge between them when it came time to spell. For example, in spelling

"propellant," a given subject might easily be able to visualize "propel" and "lant." But, especially when spelling backwards, this subject might become lost in the middle of the word. In such cases subjects were asked to imagine a bridge chunk like "ella." Often a bridge chunk is all that is needed to to be able to spell a difficult word. This was not necessary for all subjects; but quite essential for others.

The final step was using imagery to help ensure that subjects would use the spelling strategy on their own in the future. Subjects were asked to imagine typical remembered scenes when they had come across words that they did not know how to spell. They were asked to imagine themselves in those situations in the future first finding the correct spelling (perhaps by using a dictionary), and then visualizing the word with special characteristics until they could spell it backwards.

Procedure. At the beginning of session one all subjects were given a pretest. Then training commenced. Subjects in the Imagery Group were trained in the Spelling Package. Subjects in the Auditory Rule Group were taught standard spelling rules using lectures, photocopied handouts extracted from textbooks and practice-lists of words. The spelling rules pertained to "ei/ie," variant plurals, dropping a final "e" before a vowel, changes in the final "y" before plurals, and doubling consonants. This training involved the same amount of time as the training given the Imagery Group. The Auditory Rule Group was trained on rules for each of the five categories of words included in the spelling lists (see Materials section) to ensure that the strategy used by this group applied to the words it was to learn. The Control group was not trained.

After training all subjects were shown the Guidance and One-week Delay word list by use of flash cards. Imagery Group subjects were lead through

the imagery strategy; they were shown each word from the list by flash card and carefully led through steps three and four above. After the flash card was removed, one subject was chosen in an irregular manner to spell each word backwards to ensure that subjects felt compelled to use images. Auditory Rule Group subjects were carefully led through an appropriate spelling rule for each word as it was shown on the flash card. These subjects were asked to spell the word to themselves using their inner voice. Then one of them was asked to spell the word aloud. Thus, the experiences of the subjects in these two groups was comparable. Subjects in each group saw each word for the same amount of time and were guided through a specific strategy for processing the word. All subjects knew that, on a haphazard basis, they might be asked to spell each word. The major difference in these two groups was the use of a visual versus auditory strategy. Control subjects were simply shown the words by flash card and told to learn their spelling since they would be tested on the spelling in a week. Subjects were not tested on their ability to spell the Guidance and One Week Delay list of words until one week later during session two (during the Guidance and One-week Delay test). The purpose of a week's delay was to determine the permanency of the learning resulting from the use of the various strategies.

After the Guidance and One-week Delay list, all subjects were shown the Generalization and One-week Delay list by means of flash cards. Subjects in the Imagery Group were asked to use the imagery strategy. They were not, however, led through the strategy or quizzed on the backwards spelling of these words. Subjects in the Auditory Rule Group were asked to use the spelling rules that they had learned, while subjects in the Control Group were simply shown the words. Testing on the

Generalization and One-week Delay list occurred one week later. The purpose of the Generalization and One-week Delay list was to simulate ecologically valid conditions in which subjects were asked to use a learning strategy on their own and had to spell words at a later time.

The second session opened with a review of the appropriate strategy for the two training groups. The subjects were then shown the Guidance and Twenty-minute Delay list by flash cards. In the Imagery Group subjects were led through the imagery strategy for each word. In the Auditory Rule Group subjects were led through an applicable spelling rule for each word. Control subjects were merely shown the words. The words on the Guidance and Twenty-minute Delay list were tested approximately twenty minutes later during the Guidance and Twenty-minute Delay test, the purpose of which was to determine if the various strategies would produce effects under the best of conditions: (1) explicit use of each strategy and (2) a short time delay.

After learning the Guidance and Twenty-minute Delay list, all subjects were given three spelling tests: the Guidance and One-week Delay Test, the Generalization and One-week Delay test, and finally the Guidance and Twenty-minute Delay test. On the tests the subjects spelled from hearing the lists read. After the tests the subjects were debriefed and given credit for participation.

Results

Figure 1 shows the number of spelling errors out of twenty as a joint function of training group and test. As can be seen from the control curve of Figure 1, the four tests differed in difficulty slightly. These differences in difficulty were not significant; for example, the difference between the pretest and the generalization test for the Control

Group was not significant.

Insert Figure 1 about here

The most important data pattern in Figure 1 is the interaction of the three training groups with the four tests. As can be seen from Figure 1, the three groups start out essentially the same on the pretest (the small differences between groups are not significant). After that the two training groups diverge from the no-treatment control. This overall divergence between the training groups and the control group is supported by a significant Training by Testing interaction, F (6,63) = 2.78, p < .05.

Given the significant overall interaction, the differences between the two training curves were tested by *a priori* orthogonal comparisons, one-tailed, using a t-ratio (see Kirk, 1968, p. 73). Rather than using the pooled error term suggested by Kirk, individual error terms were computed for each t to keep the t-ratios fully independent (Kirk, 1968, p. 74) in a manner similar to Keppel (1982, p. 432). The small differences between the Auditory Rule Group and the Imagery Group at pretraining were not significant. After guidance and a twenty minute delay, the Imagery Group made significantly fewer spelling errors, (Imagery mean = 1.11, S = .99; Auditory mean = 2.43, S = 1.59; t = 1.90, df = 14, p < .05). Similarly, the Imagery Group made less errors on the Guidance and One-week Delay test (Imagery mean = 1.33, S = 1.41; Auditory mean = 3.85, S = 2.23; t = 2.55, df = 14, p < .025). But spelling superiority of the Imagery Group over the Auditory Rule Group on the Generalization and One-week Delay test (Imagery mean = 2.78, S = 2.78; Auditory mean = 4.43, S = 3.54)

was not significant. Yet the Imagery Group performed significantly better on the generalization test than did the Control (Control mean = 6.38, S = 3.77; t = 1.99, df = 15, $p < .05$) while the Auditory Rule Group did not differ from the the Control on the generalization test.

Discussion

In summary, both types of training were effective compared to a no-training control, but the generalization of training to new lists of words was only effective in the Imagery Group. The two training groups differed on the twenty minute and one-week delay tests, but not on the generalization test.

During the input (or coding or study) phase, the Spelling Package allows a teacher to teach students to look at an external visual representation of a word and transform it into a functionally useful internal image (marked by some visual characteristic such as a favorite color). This visual marking acts to distinguish for subjects a correctly spelled visual memory learned by use of the spelling strategy from a previous, and possibly incorrectly spelled, memory. The teacher's criterion for knowing when students have functionally useful internal images of words is when they can spell those words backwards. During the output (or decoding or performance) phase, the Spelling Package allows students to respond to auditory input (either internal auditory resulting from the writing process or external auditory resulting from a spelling question from another person) and transform it into a remembered visual image that has the appropriate visual markings thus evoking a feeling of familiarity. If the visual image is familiar, it is translated kinesthetically into written output. Thus the sequence in the performance stage of the strategy triggered from an auditory (internal or external)

sensation into an internal visual image marked by appropriate characteristics and a feeling of familiarity into appropriate kinesthetic movements to produce an external visual experience of a written word. This strategy, while it parallels that of many good spellers, is somewhat simpler and less inclusive than the one designed by Dilts (1983).

One qualification on the usefulness of this spelling strategy is it takes time and effort to build a substantial internal lexicon of correctly visualized words. In particular, poor spellers who read from partial visual cues (Frith 1978) will not have a large list of visually remembered words to refer to when spelling. The strategy does not transform a poor speller into a good speller in the sense of instant knowledge of the spelling of a large number of words. But it does something just as important. It teaches the poor speller a process which enables good spelling. This is not trivial for, as Ormrod (1986) has shown, poor spellers do not benefit as much from intentional learning as do good spellers, which is another way of saying that even when poor spellers put their minds to it, they do not have a strategy which enables them to learn the spellings of words. But, even though the spelling strategy does not give poor spellers a large number of correctly spelled words, it is certainly easy enough to use it to learn the difficult words that are repeated within, say, one assignment. In this way, assignment by assignment, an internal dictionary of correctly spelled words can be steadily built up.

The current thrust to teach students cognitive processes (e.g., Hayes & Flower, 1980) necessitates the consideration of pedagogical principles for designing effective methods for such teaching. The spelling strategy exhibits one of the most important criteria of a teaching

method--generativity. It is generative in the sense that, once taught, it allows students to create knowledge of spelling across many different situations on their own without teachers. The strategy does not merely apply to a few words but changes students' cognitve processes in a way that generalizes to learning to spell words in general. I have found this to be a confidence builder, especially in the prevalent context in which students think that processes such as spelling are what writing is about. If, for the first time, they discover that they can change some aspect of their writing ability they are likely to be open to the possibility that they can change in other, more substantive, ways.

If a strategy is truly generative, one consequence should be that its use generalizes easily to new materials. The Imagery Group showed evidence of such generalization when compared to the Control Group. But it did not show significantly superior generalization than the Auditory Rule Group. Since the rules used in the Auditory Rule Group were also generative and since the word lists on the spelling tests did not include any exceptions to these rules, it is not surprising that Imagery Group did not show significantly more generalization than did the Auditory Rule Group, especially since the strategy used by the Imagery Group was new, and even somewhat strange, and certainly not overlearned. That there evidence of generalization after one training session and one review is encouraging.

Some current data on spelling suggest a discussion of another design principle, the importance of sequencing in strategies. Sloboda (1980) concluded that good visualization is not crucial to good spelling because the ability to visualize did not map onto the differences between a group of good and a group of poor spellers. Similarly, Fisher, Shankweiler, and

Liberman (1985) concluded that ability to remember words as visual patterns did not account for the differences in spelling performance of groups of good and poor spellers. Furthermore, Mcleod and Greenbough (1980) found that good and poor spellers do not differ in memory for pictures.

While these findings appear inconsistent with the thrust of the present study, they are not. It is assumed here that people in general, and good and poor spellers in particular, do not differ in any fundamental way in their information processing abilities. It is the strategies that they use to spell that distinguishes good from poor spellers. That is, these groups differ in the systematic way that they sequence their processing of information. It is not that poor spellers cannot, or even do not, visualize words, it is that they do not use visualization in a manner that is useful for spelling. For example, some spellers might translate a word they hear externally into an internal phonetic sound sequence, then use sound spelling rules to generate internal dialogue of their voice spelling the word letter by letter and finally translate that internal dialogue into a constructed visual image. Thus the strategy is Ae --> At --> Ad --> Vi, where the At represents auditory tonal representations and Ad represents auditory linguistic representations (see Ditls et al., 1979). This strategy depends on how good the rules are that generate the At --> Ad link. For poor spellers, these rules may be faulty. As a result they will end up with visual images that are incorrect.

So it is not the ability to process visually (or in any other cognitive system) that is the problem for poor spellers, rather it is that the strategy they use does not generate standard spelling. In this sense

the above studies support the position taken here since the Spelling Package would not work if poor spellers could not visualize. In short, teaching methods are best based on the assumption that students' fundamental cognitive abilities are intact. In terms of cognitive strategies, what is needed is a careful sequencing of the cognitive processes involved in the knowledge or skill to be taught.

The next design principle addresses how to discover an effective strategy to teach students. The principle is to focus on a few excellent performers, students or professionals, to discover what they do, how they think, what their experience is. This focus on good performers has been one of the most productive outcomes of the current cognitve writing movement. Using excellence as a basis, in contrast, say, to what can be learned from focusing on poor or disabled performers, it is possible to generate a set of experiences for students that will teach them to simulate what excellent performers experience. Dilts et al. (1979) provide extensive procedures for discovering strategies, especially those overlearned and unconscious strategies underlying the familiar, everyday activities that Applebee (1985) argues are in need of more study. For example, there is ample evidence in the literature, as well as phenomenologically, that linguistic knowledge and rules underlie the spelling performance of many excellent spellers (e.g., Baron, Treiman, Wilf & Kellman, 1980; Waters, Bruck & Seidenberg, 1985) and that strategies for spelling-sound rules can be effectively taught (Drake & Ehri, 1984; Treiman & Baron, 1983). Based on this, it seems likely that effective and teachable strategies could be extracted from particularly competent "Phonecians."

Phonetic and visual strategies complement each other well in

spelling. Phonetic strategies generalize to all words in spoken vocabularies since they are based on sound-spelling correspondences. Irregular words that are exceptions to the rules raise difficulties for these strategies. But visual strategies are ideal for exceptions. Combining "Phonecian" with "Chinese" strategies, such as the one evaluated in this study, would provide students with flexible skills for spelling diverse regular and irregular English words.

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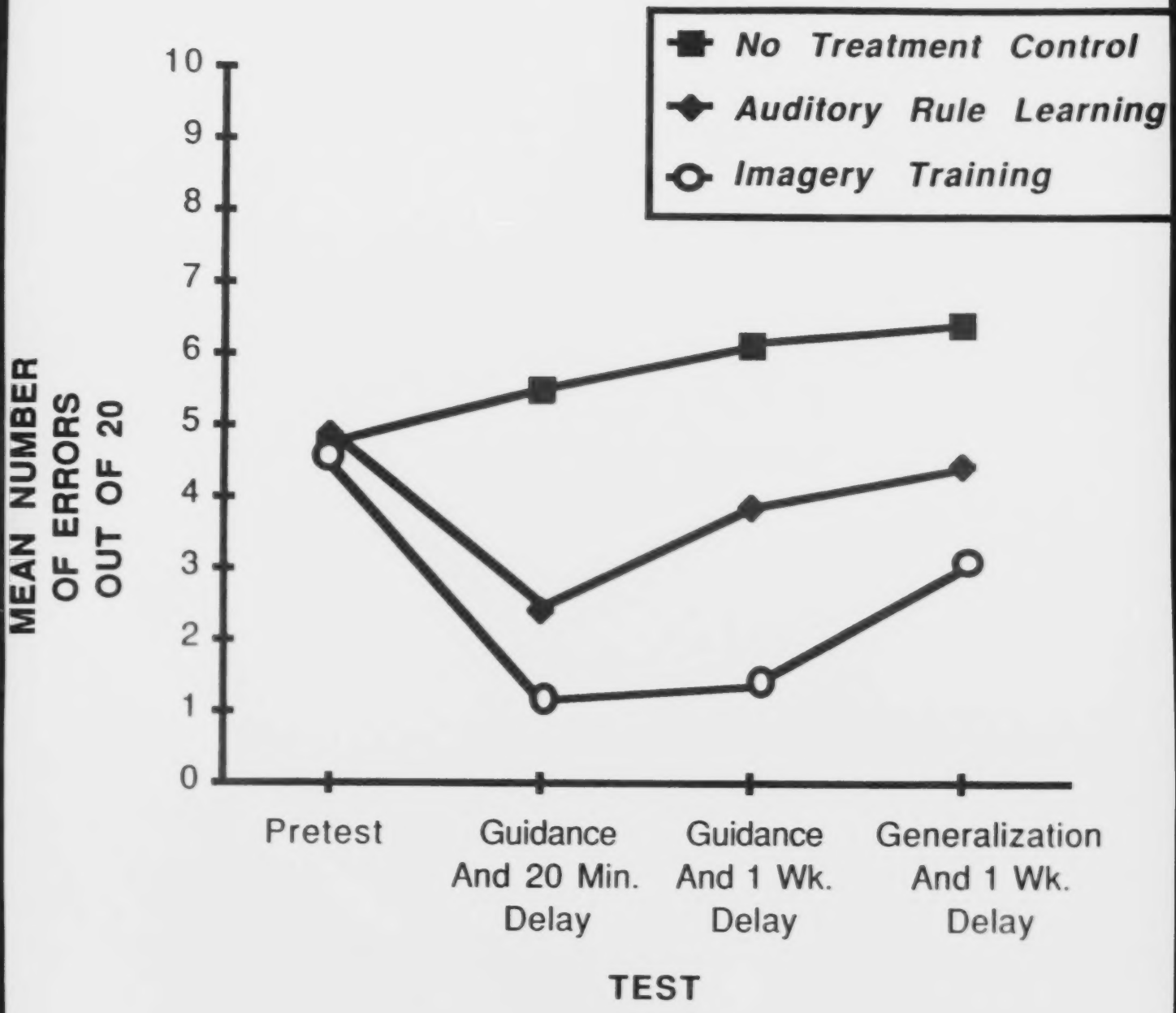
Figure caption

Figure 1. Mean number of errors as a joint function of Type of Spelling Training and Test.


No Treatment Control
Auditory Rule Learning
Imagery Training
MEAN NUMBER OF ERRORS OUT OF 20
10
9
8
7
6
5
4
3
2
1
0
Pretest
Guidance And 20 Min. Delay
Guidance And 1 Wk. Delay
Generalization And 1 Wk. Delay
TEST